Chapter X

A General Modelling and Simulation System for Sustainability Impact Assessment in the Field of Traffic and Logistics

Lorenz M. Hilty
Swiss Federal Laboratories for Materials Testing and Research, Switzerland

Ruth Meyer
University of Hamburg, Germany

Thomas F. Ruddy
Solothurn University of Applied Sciences Northwestern Switzerland

INTRODUCTION

Traffic comprises a large and persistently growing share of resource consumption and environmental stress in modern economies. Even on our way towards an Information and Knowledge Society, the demand for physical transport has not let up. Although the total physical mass transported is no longer increasing in modern economies, the distances and exchange frequencies still are, both in freight and in passenger traffic. That is making traffic with its effects on the environment into one of the most difficult problems that has to be solved if we want to attain sustainable development.

Advanced modelling and simulation techniques can, among other computer-based approaches, make an important contribution both to environmental management in the private sector (Hilty, 1995; 1996; 2000) and to sustainable urban management in the public sector (Hilty and Weiland, 1994; Weiland and Hilty, 1998). Modelling and simulation techniques are especially useful when the decision makers want to account for the dynamics of traffic development and management.

In this chapter, we describe a modelling and simulation system that models measures concerning traffic both in the public and in the private sectors, and supports assessing their ecological, economic and social consequences. The system makes it possible to integrate models on various scales (micro, meso, macro) and to represent the complex behaviour of the actors involved.

The system was developed in the three-year research project MOBILE (Model Base for an Integrative view of Logistics and Environment), funded by the *Volkswagen-Stiftung*, Germany, and jointly carried out by the University of Hamburg and the Research Institute for Applied Knowledge Processing (FAW) in Ulm.

FROM ENVIRONMENTAL IMPACT ASSESSMENT (EIA) TO SUSTAINABILITY IMPACT ASSESSMENT

In the Nineties a wide spectrum of software was developed to support environmental impact assessment (EIA). There were, for instance, new database systems for the management of environmental data (e.g. EQUEL, Plank, 1994), specific applications of geographic information systems (e.g. SAMBA, Boman et al. 1994), or expert systems for ecological (e)valuation (e.g. EXCEPT, Weiland et al. 1994).

The MOBILE System was also designed as an EIA tool, specialized to the traffic and logistics domain (Hilty and Meyer, 1996). During the course of the MOBILE project, though, it became apparent that such a politically controversial topic as traffic should be modelled under all three dimensions of sustainability (the ecological, economic and social dimensions). Thus, right during the development of the system, the goal was changed from environmental impact assessment to the more general *sustainability* impact assessment. Therefore, the main component of the system evolved to an object-oriented class library that allows the user to model large populations of market participants (such as customers, suppliers, all kinds of traffic participants) with their preferences, spatiotemporal action patterns, plans, etc., and thus incorporated economic and social dimensions of the phenomenon. This was done by implementing the approach of individual-based simulation which originally comes from biological modelling. In the following sections, we first describe the system in its function as a tool for environmental impact assessment, and then we go into its expansion for individual-based simulation, for which a case study is given.

THE MOBILE MODELLING AND SIMULATION SYSTEM

The MOBILE system supports the user in modelling and simulating a class of systems which are characterized by coordinated transformations of objects in space and time (logistical systems in the broadest sense of the term). In contrast to conventional traffic simulation approaches, in this case the systems analysis and modelling are focussed on the goal of reducing resource consumption and environmental pollution caused by the transportation processes right from the start. This approach is also called *eco-logistics*.

Sustainable Business Initiatives in the Context of Emerging Economies

Jay (Luv) M. Nathadwarawalaand Khush M. Nathadwarawala (2011). *Handbook of Research on Green ICT: Technology, Business and Social Perspectives (pp. 265-281).*

www.irma-international.org/chapter/sustainable-business-initiatives-context-emerging/48433